Public Safety Interoperability Meeting

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How to guarantee Interoperability over the Public Safety Network (1)

- Bundle the D-Block into Public Safety(?)
    - Bundling the D-Block into the Public Safety operated by the carriers would allow easier Inter-Operability

- How many operators should be selected to operate PS System(?)
    - Probably 3~4 operators
    - At most, 50 operators, but still hand-full EPS Vendors

- How to test Inter-operability(?)
    - Utilizing NIST Colorado Boulder IOT Lab
    - Or Third Party IOT Test Lab
    - Test Scenarios should be developed by the WGs
    - WG should be consist of PS Subscribers, PS Operators, Government, Device Supplier
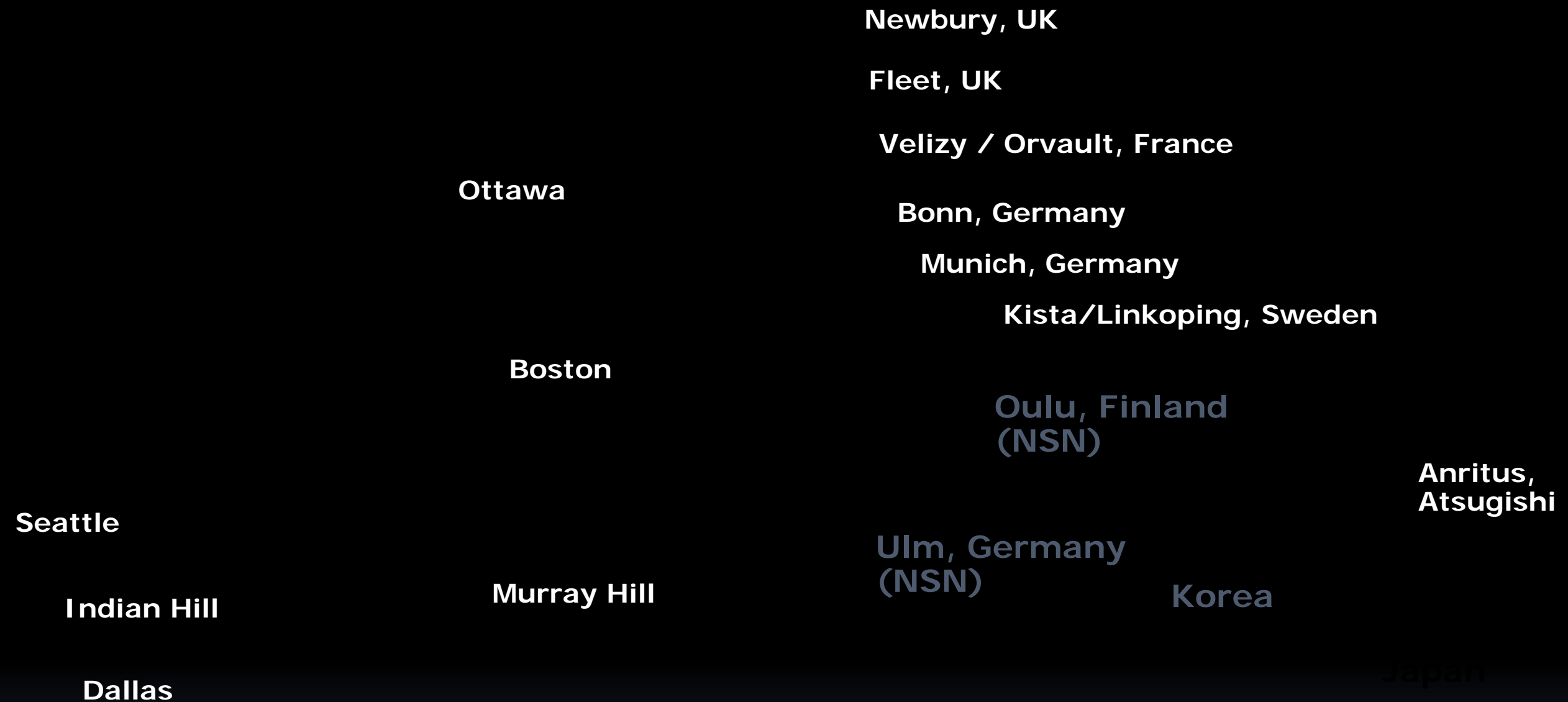   - Industry Association would take a role

How to guarantee Interoperability over the Public Safety Network (2)

- How to Operate the public Safety System(?)
  - Allow operators to run the LTE system over the spectrum combing their own spectrum with the PS Band spectrum
  - Strict priority service provisions for the PS users
- How to provide differentiated Security provisions
  - Using the UICC (Universal Integrated Circuit Card)
  - Using enhanced UICC for Public Safety Applications
  - Using two UICCs
- How to procure the networks and devices(?)
  - Somewhat Aggregated purchasing requires
  - Eliminate any special build nor special applications
  - Upgrade should be done throughout nation-wide
- Backward Compatibility to Legacy Networks, such as P25(?)
  - Cost would be incremental from the current p25 system

LG LTE IOT and Demo Sites

Newbury, UK

Fleet, UK

Velizy / Orvault, France

Ottawa

Bonn, Germany

Munich, Germany

Kista/Linkoping, Sweden

Boston

Oulu, Finland
(NSN)

Anritus,
Atsugishi

Seattle

Ulm, Germany
(NSN)

Indian Hill

Murray Hill

Korea

Dallas

Japan

LGE has 3 network/ 6 equipment partners world wide

QoS parameters can be used for public safety App

- Standards only define parameters related to QoS and their signaling. How QoS is maintained and enforced is based on implementation

- QoS parameters

  - For each EPS (Evolve Packet System: LTE+EPC) bearer

    - QoS Class Identifier (QCI)

    - Allocation and Retention Priority (ARP)

    - GBR: Guaranteed bit rate for a GBR bearer

    - MBR: Maximum bit rate for a GBR bearer. Currently spec only supports MBR=GBR

  - For multiple bearers

    - UE-AMBR (Aggregate MBR)

    - APN-AMBR (Access Point Name)

QCI

- A scalar that is used as a reference to access node-specific parameters that control bearer level packet **forwarding treatment**

- The parameter influence many implementation-specific parameters. e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration, etc.

QCI

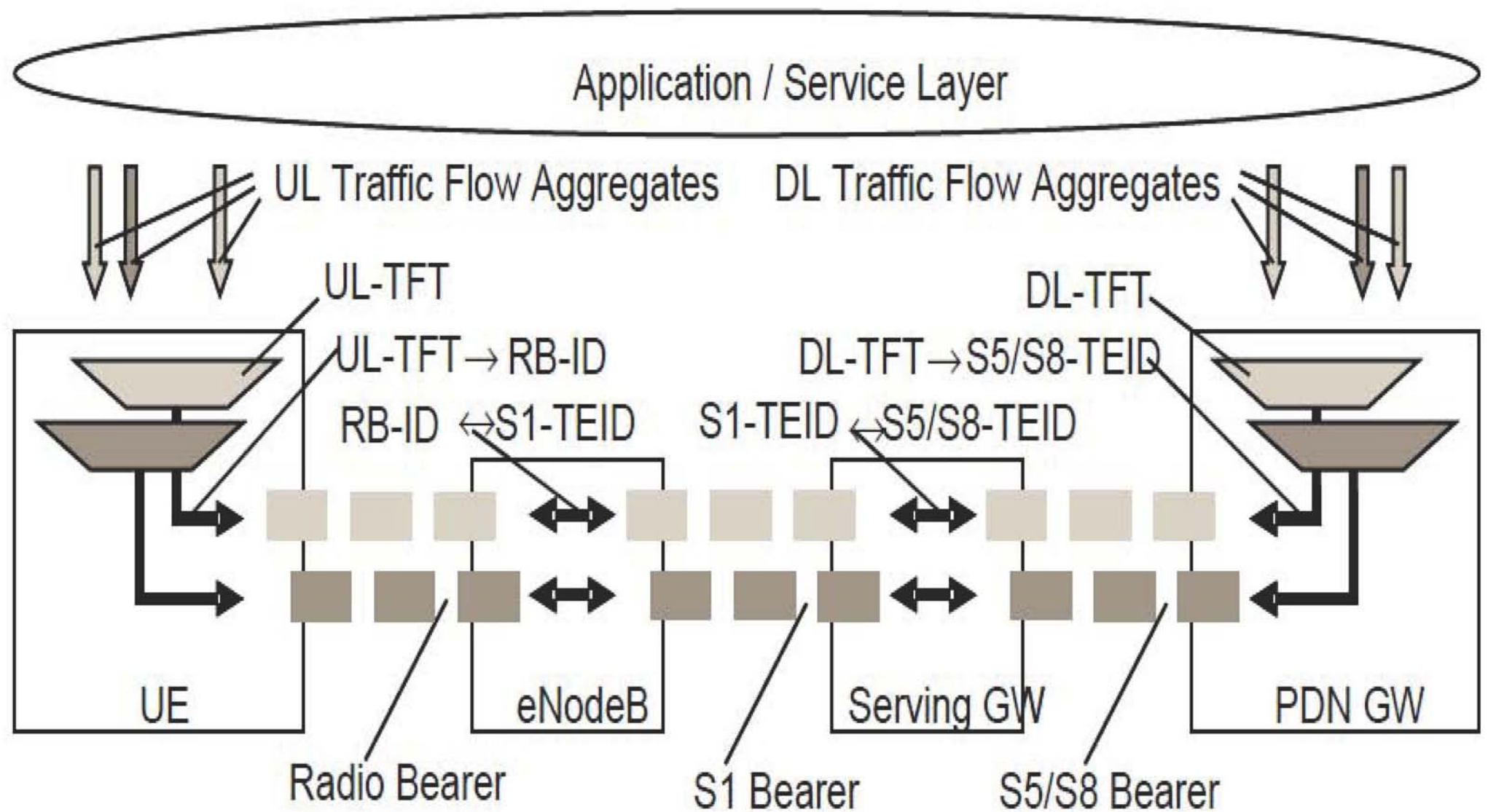| QCI	Resource Type	Priority	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10^{-2}	Conversational Voice
2		4	150 ms	10^{-3}	Conversational Video (Live Streaming)
3		3	50 ms	10^{-3}	Real Time Gaming
4		5	300 ms	10^{-6}	Non-Conversational Video (Buffered Streaming)
5	Non-GBR	1	100 ms	10^{-6}	IMS Signalling
6		6	300 ms	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7		7	100 ms	10^{-3}	Voice, Video (Live Streaming) Interactive Gaming
8		8	300 ms	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
9		9			

ARP

- Used to decide whether a bearer establishment / modification request can be accepted or needs to be rejected due to resource limitations. The 3 components of ARP are:
- Priority level
    - Used to compare which bearer is preferred
    - 1 to 15
- pre-emption capability
    - Used to decide whether this bearer can drop other lower priority bearers
- Preemption vulnerability
    - Used to decide whether this bearer can be dropped to accommodate higher-priority bearers
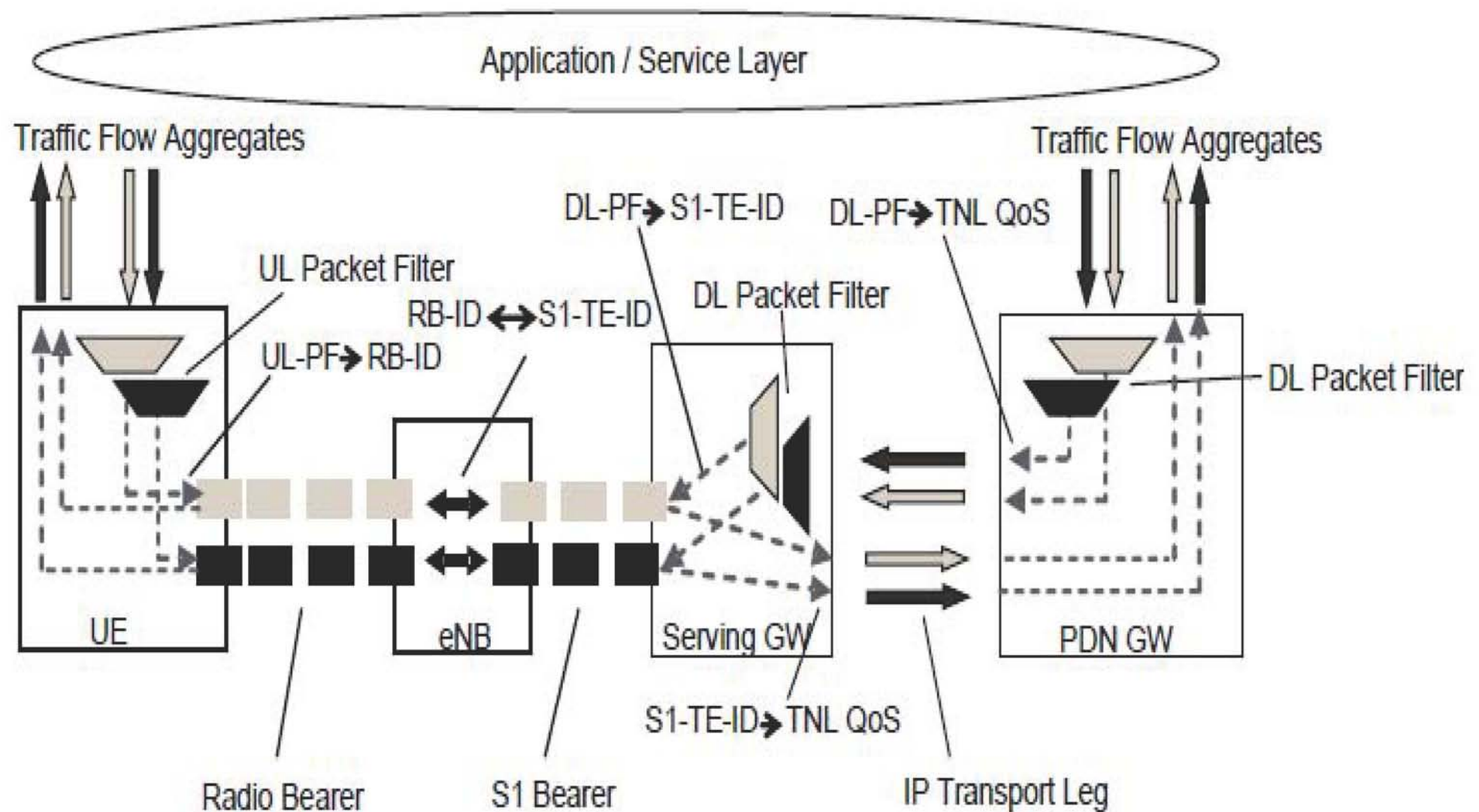
AMBR

- APN-AMBR
  - limits the aggregate bit rate that can be expected to be provided across all Non-GBR bearers and across all PDN connections of the same APN
  - Policed by PGW & UE
- UE-AMBR
  - Sum of the APN-AMBR of all active APNs
  - Policed by eNB

EPS bearers (GTP based S5/S8)

Application / Service Layer

UL Traffic Flow Aggregates   DL Traffic Flow Aggregates

UL-TFT   DL-TFT

UL-TFT → RB-ID   DL-TFT → S5/S8-TEID

RB-ID ↔ S1-TEID   S1-TEID ↔ S5/S8-TEID

UE   eNodeB   Serving GW   PDN GW

Radio Bearer   S1 Bearer   S5/S8 Bearer

LG   Life's Good

EPS bearers (PMIP based S5/S8)

UE vs. network initiated QoS

- UE initiated QoS
  - Application is running on UE, so UE naturally should provide QoS needed to the network
  - This requires a special API for the application to signal QoS to the modem. The application is not access-agnostic.

- Network initiated QoS
  - The network does not know what is the QoS needed by the application
  - However, if an application utilizes SIP, RTSP to negotiate QoS with network, the network will be able to initiate QoS needed for the application

Network initiated QoS
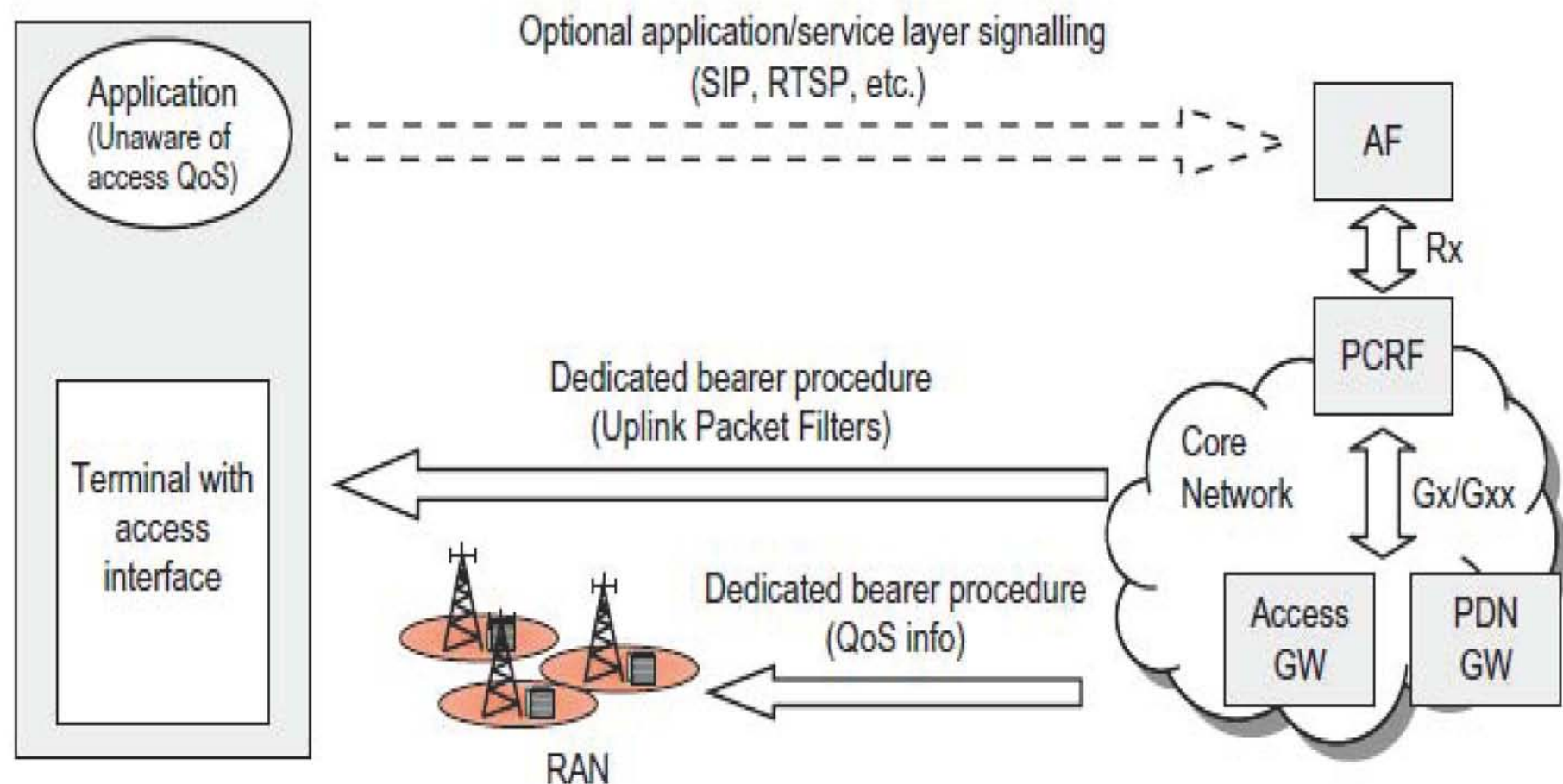
Source: M. Olsson et. Al., SAE and the Evolved Packet Core

Bearer establishment in LTE

- LTE supports both UE and network initiated QoS

- However, the decision to establish or modify a dedicated bearer can only be taken by the EPC

- UE only makes request for resource, PGW (GTP based S5/S8) or SGW (PMIP based S5/S8) decides whether it allocate a new dedicated bearer, or modify the QoS of the existing bearer to satisfy the request

Security/USIM related issues

- Using the existing USIM
  - A special APN can be used for public safety PDN connections
  - All operators need to provide access for this special PDN
  - Public safety personnel needs to contact his home operator to update the subscription profile for the special APN access
  - Either public safety authority relies on operators to authenticate the user, or other authentication functions are needed after public safety PDN connection establishment

- Using a separate USIM for public safety access
  - Device with one UICC containing one USIM app for public safety access
    - People need to carry 2 phones
  - Device with one UICC containing multiple USIM apps, one of them is for public safety access,
    - How does public safety authority coordinate with operators to issue the UICC?
  - Device with multiple UICCs, and one of them is for public safety access
  - For multiple USIMs on the same device
    - One USIM active at a time?
    - All active at the same time?
      - Dual transceivers needed?
      - "Dual USIM dual standby" with single transceiver?

Public safety network & PLMN

- Public safety network is a special PDN in HPLMN or VPLMN
  - Corresponds to the case "using existing USIM" in previous slide
  - The model is used for emergency call
  - Backward compatible to UE

- Public safety network is HPLMN
  - Corresponds to the case "Using a separate USIM for public safety access" in previous slide
  - The network providing the access is the VPLMN
  - Backward compatible to UE

- Public safety network is VPLMN
  - Corresponds to the case "Using a separate USIM for public safety access" in previous slide
  - Uses network sharing feature in LTE
  - A special PLMN id is defined for public safety
  - PLMN id not explicitly broadcasted. It is signaled by UE in RRC connection setup
  - Not backward compatible to UE

Thanks!